

Enhancing smallholders' sustainable livelihoods through cassava value chain: a study in Central Highlands, Vietnam

Ao Xuan Hoa¹, Nguyen Duc Quyen¹, Nguyen Thanh Truc², Le The Phiet³ and Vu Trinh Vuong¹

¹Faculty of Economics, Tay Nguyen University, Buon Ma Thuot City, Dak Lak province, Vietnam; ²Director of Tay Nguyen University, Buon Ma Thuot City, Dak Lak province, Vietnam; ³Head of Office of Planning-Finance, Buon Ma Thuot City, Dak Lak province, Vietnam

*Corresponding author's e-mail: aoxuanhoa@ttn.edu.vn

Cassava (*Manihot esculenta* Crantz) stands out as a remarkably multipurpose crop, playing a pivotal role in sustaining the livelihoods of small-scale farmers and bolstering their income. This study delves into the cassava value chain in Vietnam's Central Highlands, aiming to pinpoint avenues for amplifying production efficiency and refining the overall value chain dynamics. Employing a comprehensive approach, the analysis combines a survey-based questionnaire distributed to 330 smallholder farmers, focused group discussions across three provinces and in-depth interviews with key informants. The primary goal is to unearth strategies that enhance the value chain, elevate stakeholders' incomes, and ensure enduring livelihoods for households. The findings underscore that while farmers contribute significantly to the value chain by generating the highest value added, intermediaries tend to reap the most substantial profits. The intricate web of relationships among stakeholders, spanning from input providers to end-users-primarily starch and ethanol factories-is explored. The study identifies local linkages between farmers and input suppliers, encompassing both spot-market transactions and enduring partnerships. Furthermore, an imbalance in the distribution of gross profit and net profits, favoring middleman and processors disproportionately, is revealed. Nevertheless, the study emphasizes the indispensable role played by intermediaries, asserting that farmers wouldn't fully capitalize on their efforts without this crucial support.

Keywords: Cassava value chain, Small-scale farmers, Livelihood sustainability, Stakeholder incomes, Household livelihoods.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a resilient perennial crop that thrives in arid regions and plays a vital role in supporting the nutrition and livelihoods of numerous farmers (Viet *et al.*, 2013). Its versatility is evident through its utilization in the production of various products, including traditional food items, animal feed, and industrial applications such as ethanol, starch, and their derivatives (Pingmuanglek *et al.*, 2017). This crop holds immense value due to its wide range of applications across different sectors. The presence of numerous intermediaries in the cassava value chain in Vietnam is a result of insufficient commercial infrastructure and a fragmented land use pattern for cassava production (Thao *et al.*, 2013). Consequently, cassava experiences a diminished value when compared to other agricultural products within the provinces. The Central Highlands of Vietnam stands out as one of the country's most captivating

regions. Encompassing the provinces of Dak Lak, Dak Nong, Gia Lai, Kon Tum, and Lam Dong, this area boasts breathtaking natural beauty (Dam, 2020). Rural households in Central highland rely on cassava cultivation as a profitable cash crop, with its income becoming increasingly crucial for livelihoods of farmers. The cassava cultivation areas in this region have expanded from 157,800 hectares in 2018 to 168,800 hectares in 2021, as reported by General Statistics office of Vietnam (GSO). Despite slight fluctuations, the cassava yield remained relatively stable during that time, ranging from 17.99 to 19.97 tonnes per hectare (GSO, 2022b). The absence of modern inputs and enhanced varieties, along with issues related to local infrastructure and limited credit availability, pose significant challenges for cassava farmers (Fonji *et al.*, 2017). Thus, enhancing the productivity of cassava, refining the production processes, improving the quality of its products, and optimizing the distribution methods within the value chain are all factors that contribute

to an overall increase in output (Masamha *et al.*, 2017). As a result, the rise in household income resulting from these improvements would foster increased expenditures in various domains, including education, healthcare services, and other essential aspects of daily living (Rutherford *et al.*, 2016). Nonetheless, the unpredictable pricing of cassava in developing nations has been known to amplify susceptibility of agriculture households' incomes (Njukwe, *et al.*, 2014). Furthermore, farmers in this region face limited market connectivity and lack comprehensive information about the market. Therefore, building robust connections among stakeholders in the cassava value chain and improving cassava's yield are essential steps to effectively tackle these challenges. The objective of the study is to enhance and advance the cassava value chain, boost stakeholders' income, and specifically identify suitable strategies to ensure sustainable livelihoods for households. The analysis focused on examining the linkages among stakeholders in order to enhance understanding and suggest appropriate measures to enhance the resilience of the value chain of cassava. Vietnam has witnessed a notable increase in the cassava output in recent years, positioning it as the third-highest agricultural production after rice and corn. Cassava cultivation now spans across 560,000 hectares, achieving an average yield of 19.11 tonnes per hectare and an impressive annual production of 10.6 million tonnes (GSO, 2022b). Regarding the Central Highlands, from 2018 to 2022, cassava cultivation saw significant expansion, with the cultivation area increasing from 157,900 hectares to over 172,000 hectares. Throughout this period, there was a notable increase in the average cassava yield, rising from approximately 18 to 20.4 tonnes per hectare. The peak in total production reached an impressive 3.5 million tonnes.

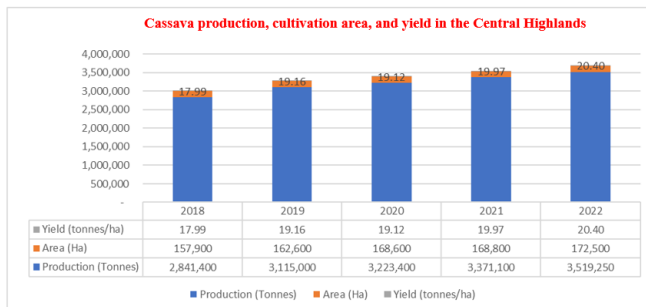


Figure 1. Cassava production, cultivation area, and yield in the Central Highlands.

Consequently, the central highlands stand as a significant region where cassava holds a prominent position among crops. The study under consideration thoroughly examines various aspects of the cassava value chain within region. To begin with, the study methodically recognizes and charts the stakeholders engaged in marketing of cassava and the

distribution channel. Furthermore, it delves into the intricacies of the profit and cost structures associated with these activities. Secondly, it examines the dispensation of benefits among the different stakeholders and conducts a thorough analysis of both gross and net profits within the cassava value chain. The study also analyzes the potential beneficiaries and explores the means through which benefits can be obtained by improving the connections among the involved stakeholders and governments. Lastly, the study investigates strategies to upgrade the cassava value chain through advancements in cassava yield. It emphasizes the significance of relationships and cooperation systems in enhancing agricultural policies. By doing so, the aim is to elevate the value chain of cassava and boost farmers' income.

MATERIALS AND METHODS

Study area: The Central Highlands form a plateau adjacent to the southern part of Laos and northeastern Cambodia. Kon Tum Province shares its borders with both Laos and Cambodia, while Gia Lai Province and Dak Lak Province share borders solely with Laos. Lam Dong Province is landlocked and lacks an international border with any other nation. The total area occupied by the Central Highlands is 54,548.30 square kilometers, with a population exceeding 6.09 million people and a regional population density of 112 persons/km² (GSO, 2022a).

DATA COLLECTION AND ANALYSES

Data collection: The collection of data was facilitated by the utilization of structured questionnaires (Fonji *et al.*, 2017). Information regarding household characteristics were gathered through a blend of sources, encompassing a survey, group discussions with head of household and interviews with important informants (Mukete *et al.*, 2018). The researchers employed a cross-sectional design, which allowed them to efficiently achieve the study objectives while streamlining the data collection process (Kothari, 2004). Using the multi-stage sampling method, the researchers chose three provinces, namely Gia Lai, Dak Lak, and Kon Tum provinces. Within each province, data collection involved conducting a questionnaire-based survey during household visits to gather pertinent information from stakeholders in the cassava value chain. The questionnaire utilized a combination of closed-ended and open-ended questions. In order to augment the survey data, the researchers collected data sourced from both primary and secondary sources, including stakeholders actively engaged in the cassava value chain. This encompassed supplier of inputs, middleman actors, and processors (Masamha *et al.*, 2018). In-depth interviews were with key informants, such as supplier of inputs, cassava growers, stakeholders in cassava value chain and directors of the local starch factories. These interviews took place in



different locations in study site. Focus-group discussions were carried out with cassava farmers at the study site, providing valuable insights and perspectives from the farmers. Additionally, field trips were undertaken to gather both primary and secondary data, ensuring a comprehensive approach to data collection for the research. The study included a combined sample of 330 households spread across three provinces. Additionally, twenty middlemen and key informants were interviewed. Moreover, an interview was conducted with the director of a cassava starch factory operating in this region.

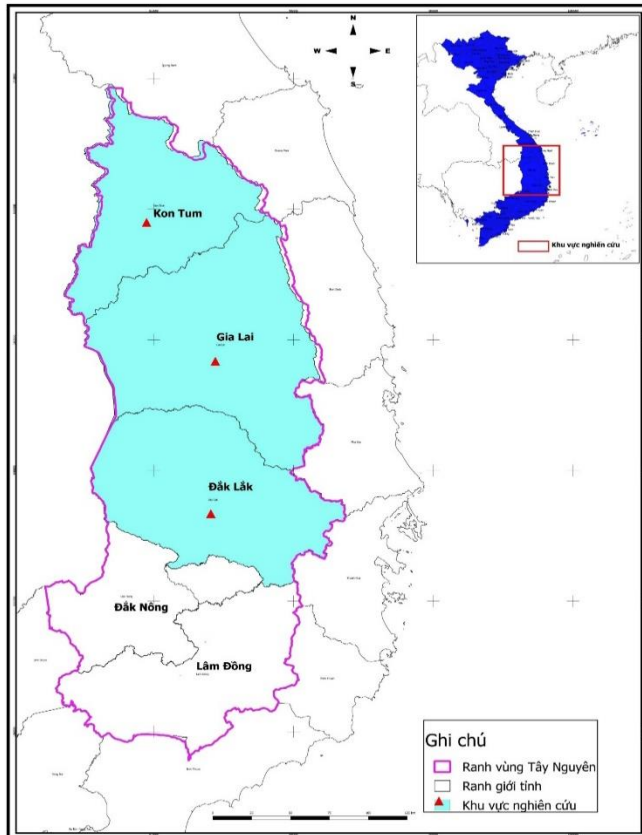


Figure 2. Study area's location map.

Analyses: During the data analysis collected from the survey based on questionnaires, several steps were taken. Initially, the data underwent coding and data entry using the Statistical Package for the Social Sciences (SPSS) version 20 (Mukete *et al.*, 2018). Subsequently, the data were subjected to thorough analysis using both the SPSS software and Microsoft Excel. These tools were utilized to process the data, generate statistical insights, and present the findings in a meaningful manner. The study utilized a combination of qualitative and quantitative analysis methods to understand the duties and actions of the key actors involved (Fonji *et al.*, 2017). In this study, the examination of the cassava value

chain was conducted using the value-chain analysis methodology. Additionally, quantitative methods were employed to calculate and determine value-chain upgrade solutions (Naziri *et al.*, 2014). In this research, notable elements of the cassava value chain in the Central Highlands were recognized. These elements included value added (VA), output (Y), intermediate input (II), gross profit (GPr), and net profit (NPr), among other pertinent economic parameters. The calculation of value added (VA) served as a means to quantify the fresh wealth generated by a productive activity, thereby assessing the role of the manufacturing process in fostering economic expansion.

The calculation of value added (VA) was established using the following formula: $VA \text{ (value added)} = Y \text{ (Output)} - II \text{ (Intermediate input)}$.

Where Y (output) total sale value, II (Intermediate input) such as: Seedlings, pesticide and fertilizer. Gross Profit (GPr) was determined as the difference between value-added (VA) and the sum of wages and salaries, interest charges, and taxes. $GPr = NPr + \text{Depreciation}$

GPr quantifies the economic gain or loss experienced by an actor after covering all current production costs. On the other hand, NPr (Net profit) reflects the economic gain or loss, considering both the present production costs and predictable expenses related to actual investment.

RESULTS

Overview of participants in the value chain of cassava

Supplier of inputs: The study revealed the existence of input connections and output relationships within the cassava value chain. Input providers were identified as backward-linked actors, serving a crucial role in supplying agricultural products to fulfill farmers' requirements, including seedlings, fertilizer, and pesticide. Additionally, input providers played a significant role as an origin of informal financing for various farming operations. Establishing a robust connection between input providers and cassava growers holds the promise of improving the value chain. This can be achieved by enabling farmers to secure informal credit, thereby lessening their dependence on formal banking or other credit avenues. Moreover, this collaborative relationship can empower small-scale household farmers coming together to combine their resources, enabling them to collectively address tasks that might otherwise be challenging for individual farmers to undertake.

Agricultural Producer (Farmer): The initial actor in the value chain primarily operates in countryside, where an unequal infrastructure has evolved. In this context, the farmer faces a disadvantage as they are required to provide fresh cassava to the purchaser (Njukwe *et al.*, 2014).



Table 1. Socio-economic profiles of respondents within the study sites.

Profiles		Province			Total	%
		Dak Lak	Gia Lai	Kon Tum		
Age of the respondent	< 30	8	12	5	25	7.58
	30 - 40	29	36	21	86	26.06
	40 - 50	36	28	44	108	32.73
	50 - 60	31	28	28	87	26.36
	> 60	6	6	12	24	7.27
		110	110	110	330	100.00
Education attainment level	Illiteracy	10	7	5	22	6.67
	Primary school	29	20	17	66	20.00
	Secondary school	59	66	69	194	58.79
	High school	12	17	19	48	14.55
		110	110	110	330	100.00
Years of farming experience of the farmer	< 5	13	14	7	34	10.30
	5 - 10	32	39	30	101	30.61
	10 - 15	45	33	51	129	39.09
	15 - 20	13	19	15	47	14.24
	> 20	7	5	7	19	5.76
Total		110	110	110	330	100.00

Table 1 illustrates the socio-economic traits of household farmers at the study locations. Notably, the mean age of the participants significantly influences the demographics, with 85.15% falling within the age range of 30 to 60 years, and an impressive approximately 79% having attained at least a secondary level of formal education. Furthermore, a substantial majority of farmers (89.70%) possessed over 5 years of experience in cultivating cassava. The fresh cassava they produce is primarily sold within the local vicinity, with large traders and factories being the primary buyers. Additionally, farmers also sell their produce to other collectors, both at the village market and directly from their farms. Nevertheless, this connection between the various actors exists solely during the harvest season. The seedlings used for cultivating cassava in the region originate from diverse sources. These include the farmers' own farms, neighboring farms, local seeding centers, and donations from international organizations engaged in cassava cultivation research. Small-scale farmers commonly cultivate cassava as a mono-crop on fragmented land ranging from approximately 0.1 to over 4.2 hectares. They grow cassava for both food consumption and utilization in the industrial sector. Due to its labor-intensive nature, cassava production stands as one of the most favorable choices for enhancing a livelihood of farmer, particularly in rural areas abundant with available labor.

Collectors and Traders: They fulfill a crucial role in connecting the growing and consumption of fresh and dried cassava chip. Collectors can be categorized according to the amount of cassava they acquire, including local and other collectors, encompassing both residents from the area and those from various regions. The method of collecting cassava varies based on the purchasing capacity of the collector. Local collectors typically acquire cassava directly from small-scale

farmers and individuals who gather cassava residue around the village post-harvest. Bigger collectors have the capacity to purchase fresh cassava from preceding actors while also serving as a source of information for other stakeholders involved in the process. The majority of the harvested cassava is then traded to both starch and ethanol factories, while a smaller portion is supplied to the cassava factory in the Central Highlands and various other regions.

Processors: The majority of cassava cultivated in Central Highlands finds its way to local starch or ethanol factories across region. This area is home to twelve starch factories, exclusively owned by the Gia Lai and Dak Lak Tapioca Starch Company, each with daily processing capacities varying between 250 to 300 tonnes of cassava starch. Furthermore, Dai Viet, established in 2010, serves as one of Vietnam's largest ethanol factories and relies on cassava as a fundamental raw material. This factory boasts an impressive installed capacity, capable of producing up to 160 tonnes of ethanol per day. Additionally, a small portion of cassava roots is used for human use, often in local traditional food dishes.

Economics analysis of cassava value chain in the Central Highland Cassava farmers: Cassava tuber yields averaged around 21.2 tonnes per hectare. With a conversion rate of 50%, farmers were able to obtain approximately 10.5 tons of dried cassava from the harvested quantity of fresh cassava. Producers had multiple options available for selling their products to potential buyers. The cassava growers' selling decisions varied based on their individual targets and price updates. They sold 25% to collectors, 35% to traders, 30.5% to starch factories, and 8% to the ethanol factory, respectively (Fig.8). The price of cassava shows considerable variability, especially in relation to the pricing of exported starch, as highlighted by [Son et al. \(2016\)](#). According to the result, the farmers' income was VND 47.262 million or approximately US\$ 1,842 per ha (calculated at the exchange rate of US\$ 1 = VND 23,388) (HSBC, 2023). In the cassava value chain analysis, the intermediate inputs accounted for 8.84% of the producers' income, with the largest proportion (greater than 46%) attributed to seedlings (VND 1.943 million) (Table 2). The added value totaled VND 43.084 million (equivalent to US\$ 1,842), constituting 91.16% of the total production. This calculation reinforces the notion that cassava is an advantageous crop, significantly contributing to the income of household farmers with notable economic efficiency. This is evidenced by a gross profit (GPr) of VND 31.814 million per hectare, coupled with affordable intermediary input. Cassava was valued at over VND 2.2 million per tonne, and the average yield per hectare reached around 21.23 tons. According to the study, regardless of various market price and productivity scenarios, producers can consistently achieve profits from their cassava production. This advantageous situation makes the cassava value chain attractive to household farmers who are involved in it. In the least favorable situation, with low selling prices and productivity,



the farmers' gross profit (GPr) was VND 1,142 per kg. Conversely, in the most favorable scenario marked by a prosperous market and high productivity, the producer's GPr reached VND 2,282 per kg (Fig. 3).

Table 2. Analysis of key indicators in the value chain of fresh cassava per hectare.

Items	Value (VND 1,000)	Value USD	(%)
Output (Total Production)	47,262	2,020.80	100.00
Intermediate input	4,179	178.67	8.84
Seedling	1,943	83.09	4.11
Fertilizer	1,512	64.65	3.20
Pesticide	277	11.83	0.59
Transporting	424	18.11	0.90
Fuel	23	0.99	0.05
Value added	43,084	1,842.12	91.16
Land preparation	1,137	48.60	2.41
Planting labour	2,186	93.48	4.63
Fertilizer labour	235	10.07	0.50
Weeding labour	1,442	61.67	3.05
Pesticide labour	173	7.41	0.37
Harvesting labour	5,107	218.35	10.80
Transport labour	883	37.74	1.87
Interest	107	4.56	0.23
Gross Profit (GPr = NPr)	31,814	1,360.25	67.31

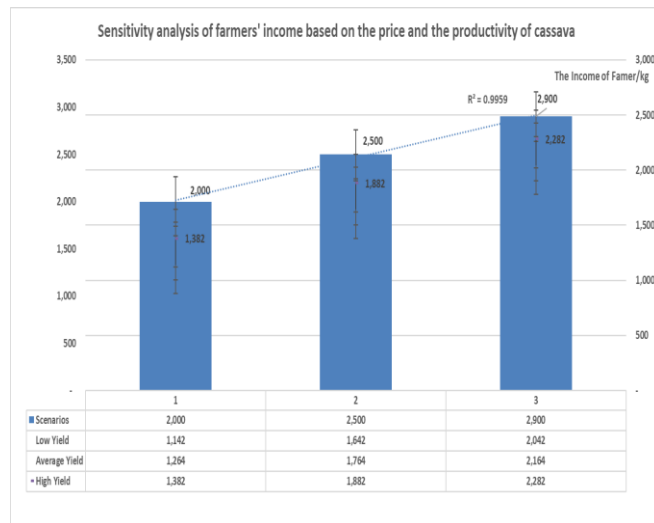


Figure 3. Analyzing the sensitivity of farmers' income with respect to the price and yield of cassava (VND/kg).

The perspective of the collector: The financial analysis from the collectors' perspective, as displayed in Table 3, reveals that the total expenditure was approximately VND 2,468 per kg for fresh cassava. The cost of fresh cassava represented the largest portion at around 82.06%, followed by cost of transport at 9.59%. At this particular stage, the value added was relatively lower for the collectors, at 8.3% compared to

approximately 91% for fresh cassavas as created by the farmers. Nonetheless, collectors purchased a significant quantity of produce, resulting in higher GPr (gross profit) and NPr (net profit) of VND 124,230 (equivalent to US\$ 5.32) and VND 123,000 (equivalent to US\$ 5.27) per ton, respectively, compared to what the farmers earned.

The trader's viewpoint: The traders' business model closely resembles that of collectors. They purchase fresh cassava from producers during the months of January and May. However, the majority (97%) (Fig. 8) of their cassava supply comes from collectors. On a typical day, the traders buy average 23.5 tons of cassava. However, during the harvesting season, this amount surges to a peak of 50 tons per day. Remarkably, the purchase price offered by traders closely resembles that given payment to by collectors who directly purchase cassava from growers. Additionally, traders often engage in negotiations with farmers to establish the price of cassava before the harvest. However, fluctuations in the market can influence this approach.

Table 3. Analysis of key indicators in the value chain of fresh cassava per tonne from collector.

Item	Value (1,000VND)	Value USD	Proportion %
Output	2,591.05	111.02	100.00
Intermediate input	2,375.95	101.81	91.70
Cassava root	2,126.25	91.11	82.06
Transportation	248.60	10.65	9.59
Communication	1.10	0.05	0.04
Value added	215.10	9.22	8.30
Labour wage	49.88	2.14	1.93
Fee of interest	13.49	0.58	0.52
Cost of handling	26.87	1.15	1.04
Gross profit (GPr)	124.86	5.35	4.82
Depreciation	1.32	0.06	0.05
Net profit (NPr)	123.54	5.29	4.77

For example, should the market price exceed the pre-agreed rate before harvesting, the acquisition of cassava will be concluded according to the prevailing market price. On the other hand, if the price of market decreases, the transaction will proceed according to the pre-established price, demonstrating an equitable trading relationship between all parties involved in the value chain of cassava. The mean price of selling was approximately VND 2.935 million (equivalent to US\$ 125.78) per ton and the net profit obtained was approximately VND 92,000 (equivalent to US\$ 3.94) per ton for cassava root (Fig 4). However, the traders have a crucial role in their interactions with farmers as they often facilitate the provision of essential resources like fertilizers, pesticides, and herbicides. Additionally, they also offer financial support to cover the living cost of smallholder farmers.



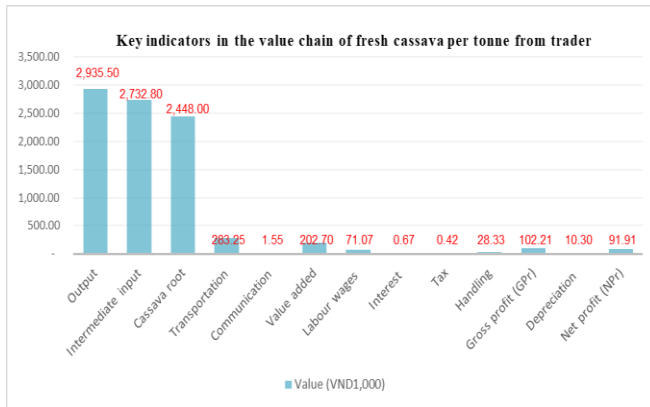


Figure 4. Key indicators in the value chain of fresh cassava per tonne from trader

The perspective of the starch factory: Starch factories primarily source their feedstock are mostly obtained from traders (80% of the traders' total sales volume) and directly from other producers account for 20%. The intermediate cost of producing one ton of starch of cassava is approximately US\$ 542.3 (Fig. 5).

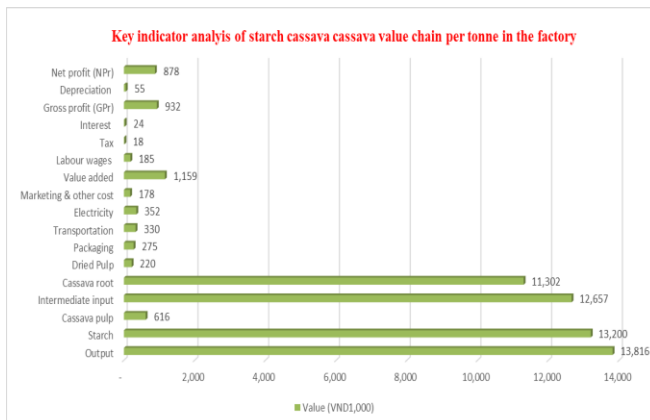


Figure 5. Analysis of key indicators of starch cassava per tonne from the factory.

According to [Thao et al. \(2013\)](#), the conversion ratio for fresh cassava is almost 3.5 tons of cassava needed to produce one ton of cassava starch. Furthermore, the factory also generates a pulp residue during the processing, which can be sold in the market. Thus, the factory's gross profit, encompassing income from both pulp residue and cassava starch, was estimated to be around VND 0.93 million (equivalent to US\$ 40) per ton. Nevertheless, based on the research of [\(Son et al., 2016\)](#), the cost of cassava starch exhibits significant variability due to fluctuations in the starch's export price. Consequently, the overall expenses and profits have remained unstable throughout the years, posing a challenging situation for the majority of cassava starch factories at present.

The ethanol factory's viewpoint: Currently, there is only one operational ethanol plant with a capacity of over 50 thousand tons per year, and that is the Dai Viet ethanol plant located in Dak Nong province in the Central Highlands region of Vietnam. However, it can only produce 96% ethanol, which does not meet the standard required for the production of E5 biofuel (a blend of 5% ethanol and 95% gasoline, typically with Ron 92 or Ron 95 gasoline). At present, bioethanol with a concentration of 96% is utilized in various sectors and for different purposes, such as in industries, food, and pharmaceuticals. As a result, the products produced by the plant entirely fulfill domestic demands. However, there is promising potential for exporting the products to specific international markets, particularly to the Chinese market, in the near future. Figure 6 illustrates that with the current selling price of VND 17,416 (approximately US\$ 745) per ton, each ton of the factory's product generates a gross profit of VND 938 (Approximately \$40 US dollars) after accounting for all expenses. However, the factory is currently encountering a notable challenge where the cost of imported bioethanol at the Port in Vietnam is below the manufacturing expenses of the factory. Figure 6 shows the allocation of value added and net profit among the stakeholders involved in the cassava value chain, including farmers, ethanol and starch factories, as well as collectors and traders, receiving approximately 38.9%, 30.87%, 22.22%, 4.12%, and 3.89% respectively. Regarding net profit sharing, farmers receive the highest proportion at 46%, followed by the cassava starch factory at 27%, and next is the ethanol production plant, collectors, and finally the traders with respective shares of 20%, 4%, and 3%.

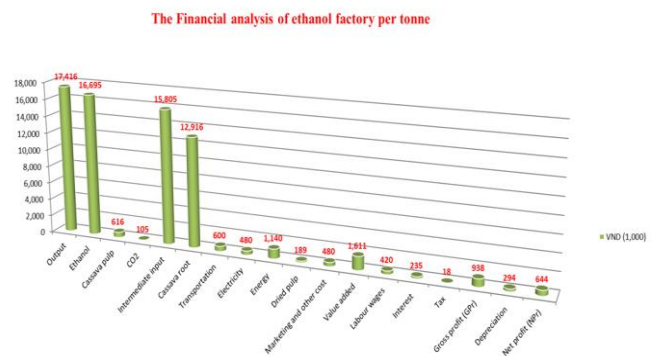


Figure 6. The financial analysis of the ethanol factory per ton.

The data suggests that farmers contribute significantly to the value chain, generating the highest value-added. However, it is undeniable that starch and ethanol processing factories, being responsible for processing the largest cassava volumes, garner the highest absolute benefits. Despite this, the equitable distribution of value acknowledges the substantial contribution made by farmers among the stakeholders.



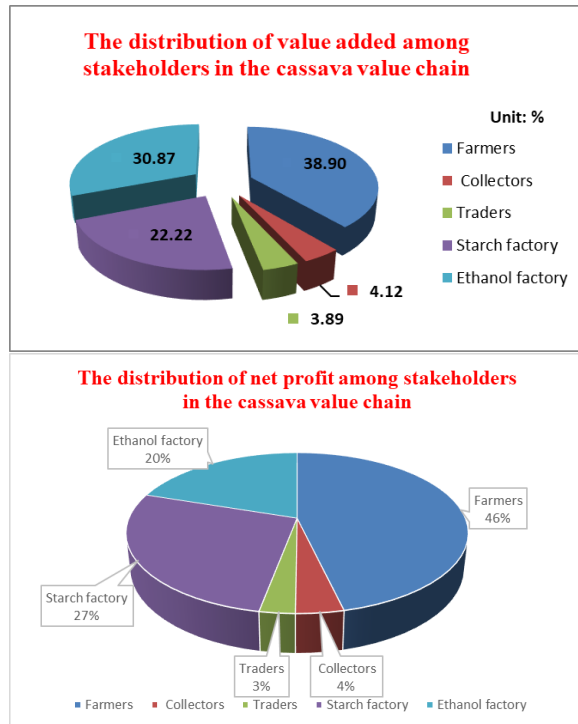


Figure 7. The gross profit and value-added distribution among the stakeholders

At present, there exist several channels of distribution, starting from its farming by growers to reaching the final stage in the value chain of cassava. Nevertheless, the study reveals that only two most important channels significantly impact the income of the surveyed households. Firstly, cassava is provided to starch enterprises for starch production with 91% of the output intended for the export market and the remaining 9% allocated for the national market. The supplementary channel entails delivering cassava to the ethanol factory, where it functions as the main raw material for ethanol production, meeting the needs of various consumers within the internal market. Especially, ethanol is used as an ingredient to blend with gasoline, either Ron 92 or Ron 95, to create E5 biofuel.

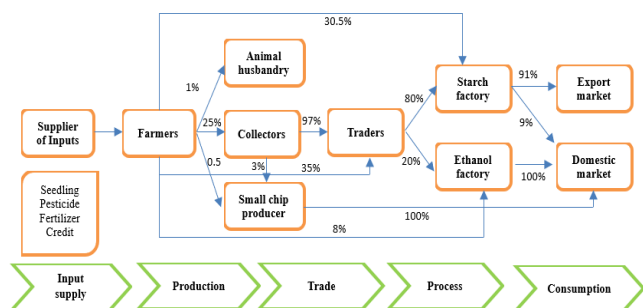


Figure 8. The distribution channel of cassava value chain in Central Highlands, Vietnam.

DISCUSSION

The results presented in this study demonstrated differing conclusions regarding the educational backgrounds of the participants in comparison to the research conducted by Njukwe *et al.* (2014). In their study, 23% of the farmers had solely finished primary education, while in our present investigation, the common of members (79%) had achieved a minimum of secondary school education. This higher level of education among the participants may provide them with an advantage when it comes to cultivating cassava. In addition, there is a slight discrepancy with the results of Njukwe *et al.* (2014), who reported that in Cameroon, over 90% of the farming population cultivates cassava, mostly as an intercrop in small plots ranging from 0.4 to 12 hectares. Meanwhile, the average land size of the farmers in our study ranged from 0.1 to 4.2 hectares. In addition, there is a slight discrepancy with the results of Njukwe *et al.* (2014), who reported, over 90% of the farming population cultivates cassava, mostly as an intercrop in small plots ranging from 0.4 to 12 hectares. Meanwhile, the average land size of the farmers in our study ranged from 0.5 to just under 4.5 hectares. Furthermore, our findings align with the observations made by Naziri *et al.* (2014), indicating that cassava is predominantly cultivated as a mono-crop by household farmers in small plots in Southeast Asian regions and Africa. Our study also aligns with Andersson *et al.* (2016), indicating that both cassava leaves and roots are utilized for various purposes. Furthermore, our findings propose that the primary focus for enhancing the value chain should be on ensuring that the products meet the market's demands, which aligns with the recommendation made by Thanh *et al.* (2017), for improving the value chain of exported agricultural products. Our study supports Fonji *et al.* (2017), findings on cassava cultivation in central Cameroon. The ongoing investigation reveals that insufficient yield and competitiveness may result from factors such as deficient infrastructure, inadequate farmer skills, limited capital resources, and a lack of coordination among local authorities in the cassava value chain (Fonji *et al.*, 2017). Additionally, as highlighted in previous research, the key to achieving success in all partnerships lies in formalizing them through appropriate contracts that explicitly outline the Duties and tasks of the involved actors along the entire chain. According to our findings, enhancing the cassava value chain can be accomplished through collaborative efforts among the stakeholders. Furthermore, our research revealed that over (98%) of the cassava tubers are utilized as raw materials for both starch and ethanol processing. This utilization occurs through direct sales or sales facilitated by collectors or traders, with approximately 2% being used for other resolves. Our findings are of significant importance and diverge from certain prior studies. For instance, observed that an average of



40% of the cassava in Cameroon was allocated for sale in the market.

Conclusion: In this research, a thorough investigation of the cassava value chain was developed through a blend of structured and semi-structured interviews with diverse participants in the cassava value chain. Moreover, farmer-focused group discussions and in-depth interviews with crucial informants were conducted (Andersson *et al.*, 2016). To further enhance the understanding, direct participant observations were carried out in Central Highlands. Furthermore, the study revealed that household farmers belonging to ethnic minority groups experienced significant physical losses during the phase of marketing their products. This was attributed to their practice of storing fresh cassava for several days post-harvest before selling it to collectors or traders. Specifically, the household farmers in the Central Highlands cassava production areas face resource limitations. Despite this, their incomes are on the rise due to the current upward trend in cassava prices. Moreover, a majority of the farmers lack adequate capital to invest in technologies that could enhance cassava productivity. As a result, they generate lower profits compared to other groups engaged in trading or processing cassava. The study discovered that intermediaries play a significant role in bridging the interval between the cultivation and consumption phases in the cassava value chain. Not only do they supply essential input materials, but they also offer informal credit, enabling farmers to engage in effective cassava cultivation practices. Based on our findings, it appears that processors are currently experiencing reduced profits compared to the past due to the rising costs of input materials. Currently, the factories, which are the primary consumers of over 98% of the cultivated cassava, specialize in producing starch and ethanol. Furthermore, this study uncovered that despite the existence of several distribution channels, two major channels overwhelmingly dominate the value chain of cassava. Hence, effectively tackling the emerging opportunities and challenges in the cassava market necessitates cross-sectorial participation involving a wide array of stakeholders in the value chain. Hence, effectively tackling the emerging chances and challenges in the cassava market requires the engagement of stakeholders across various sectors in the value chain. Remarkably, government policies can play a crucial role in providing input factors for cassava production. In conclusion, this discovery has specifically emphasized the value added and financial costs, including gross and net profits of stakeholders. The study lacks a comprehensive analysis of the government's role in mitigating risks within the market, including aspects like price subsidies and rural credit policies. Therefore, further research is strongly recommended to explore policy reforms that can effectively enhance the value chain of cassava, benefiting both farmers and other participants involved.

Author's contributions: Ao Xuan Hoa conceived the idea, planned the study, data analysed and wrote the manuscript; Vu Trinh Vuong did reviewing and editing; Nguyen Thanh Truc, Le The Phiet conceived the idea and supervised, Nguyen Duc Quyen assisted in the field trip and proof reading.

Conflict of interest: The authors declare that there is no conflict of interest

Acknowledgement: The authors would like to convey their appreciation to the Ministry of Education and Training of Vietnam. Additionally, we extend our gratitude to the respondents and local authorities in the Central Highlands. Funding: The authors acknowledge Ministry of Education and Training of Vietnam for providing research funding through code number B2021-TTN-02

Ethical statement: This represents original research that has not been published elsewhere, and the authors confirm the absence of any conflicts of interest.

Availability of data and material: We declare that the submitted manuscript is our work, which has not been published before and is not currently being considered for publication elsewhere.

Code availability: Not applicable

Consent for publication: All authors submitted consent to publish this research. article in JGIAS

REFERENCES

- Andersson, K., J. B. Lodin and L. Chiwona-Karlton. 2016. Gender dynamics in cassava leaves value chains: The case of Tanzania. *Journal of Gender, Agriculture and Food Security* 1:84-109. <http://ageconsearch.tind.io/bitstream/246031/2/JGAFS-122016-5>.
- Dam, H. 2020. Travel Guide to Central Highlands of Vietnam. Vietnam Discovery. <https://vietnamdiscovery.com/central-highlands/>
- Fonji, F. T., C. N. Temagne and F. A. Ngome. 2017. Quantitative Analysis of Cassava Products and Their Impacts on the Livelihood of Value Chain Actors : Case of the Centre Region of Cameroon. *Annual Research and Review in Biology* 1:1-14.
- GSO. 2022a. Area, population and population density in. 2022 by province. In *Statistic Yearbook of Vietnam 2022*. Available online at <https://www.gso.gov.vn/en/population/>



- GSO. 2022b. Production of cassava by province by Cities, provinces and Year. General Statistics Office. Available online at [https://www.gso.gov.vn/en/px-web/?pxid=E0631andtheme=Agriculture%2C Forestry and Fishing](https://www.gso.gov.vn/en/px-web/?pxid=E0631andtheme=Agriculture%2C%20Forestry%20and%20Fishing)
- HSBC. 2023. The exchange rate of foreign currency against the Vietnamese Dong (VND). HSBC Bank (Vietnam). Available online at <https://www.hsbc.com.vn/foreign-exchange/rate/>
- Kothari, C. R. 2004. Research Methodology: Methods and Techniques. In New Age International (P) Ltd (2). New Age International. Available online at <https://doi.org/10.1017/CBO9781107415324.004>
- Masamha, B., V. Thebe and V. N. E. Uzokwe. 2018. Mapping cassava food value chains in Tanzania's smallholder farming sector: The implications of intra-household gender dynamics. *Journal of Rural Studies*, 7(58): 82–92.
- Masamha, B., V. N., Uzokwe, F. E. Ntagwabira, D. Gabagambi and P. Mamiro. 2017. Gender Influence on Participation in Cassava Value Chains in Smallholder Farming Sectors: Evidence From Kigoma Region, Tanzania. *Experimental Agriculture*. Available online at <https://doi.org/10.1017/S0014479717000552>
- Mukete, B., Y. Sun, D. Etongo, R. Ekoungoulou, F. Folega, S. Sajjad, M. Ngoe and G. Ndiaye. 2018. Household characteristics and forest resources dependence in the Rumpi hills of Cameroon. *Applied Ecology and Environmental Research* 16:2755-2779.
- Naziri, D., W. Quaye, B. Siwoku, S. Wanlapatit, T. V. Phu and B. Bennett. 2014. The diversity of postharvest losses in cassava value chains in selected developing countries. *Journal of Agriculture and Rural Development in the Tropics and Sub Tropics* 115:111-123. <https://www.jarts.info/index.php/jarts/article/view/2014121946902>
- Njukwe, E., R., Hanna, P. S. Sarr, A. Shigeru, H. Kirscht, A. Mbairanodji, T. Ngue-Bissa, and A. Tenkouano. 2014. Cassava value chain development through partnership and stakeholders' platform in Cameroon. *International Journal of Agricultural Policy and Research* 2:383-392.
- Pingmuanglek, P., N. Jakrawatana and S. H. Gheewala. 2017. Supply chain analysis for cassava starch production: Cleaner production opportunities and benefits. *Journal of Cleaner Production* 162:1075-1084.
- Rutherford, D. D., H. M. Burke, K. K. Cheung and S. H. Field. 2016. Impact of an Agricultural Value Chain Project on Smallholder Farmers, Households, and Children in Liberia. *World Development* 83:70-83.
- Son, D. Van, D. X. Lam, K. Fahrney, C. Thi and L. Thuy. 2016. Study on Improvement of Cassava Value Chain in Quang Binh. *International Journal of Political Science (IJPS)* 2:25-34.
- Thanh, P. C., V. P. Tan and P. X. Thu. 2017. Enhancing the Value Chain of Exporting Agricultural Products in the Southeastern Vietnam Focus Economic Region-SOFER. *Universal Journal of Management* 5:1-13. DOI: 10.13189/ujm.2017.050101
- Thao, N. T., T. V. Phu, C. K. Son, L. H. Nga, N. T. H. Duc, B. Ben, N. Diego and T. K. Anh. 2013. Application of value chain analysis in understanding the losses and wastes of cassava in Vietnam. *Journal of Science and Technology* 51:70-76.
- Viet, H. C., Quoc, H. T., Gia, L. Van and An, N. Van. 2013. Value-chain analysis of cassava in south- central coastal Vietnam. In S. Mann, M. C. Webb, and R. W. Bell (Eds.), *Sustainable and profitable crop and livestock systems in south-central coastal Vietnam* Proceedings of the final workshop held in Quy Nhon, Vietnam. pp. 5-6 March 2013: Vol. Aciar Proc (pp. 127-139). The Australian Centre for International Agricultural Research (ACIAR), GPO Box 1571, Canberra ACT 2601. Available online at <https://www.aciar.gov.au/node/12291>.

